

What is claimed is:

1. A switching power supply apparatus having a serial circuit, including a primary coil of a transformer and a main switching device, connected between a positive and a negative power supply line connected to a direct-current power source, the switching power supply apparatus outputting a direct-current voltage obtained by rectifying with a rectifier a high-frequency voltage induced in a secondary coil of the transformer by the main switching device performing switching operation,

wherein the switching power supply apparatus uses as a feedback signal a result of comparison between the direct-current voltage and a predetermined reference voltage, and drives the main switching device by turning on and off, according to a signal level of the feedback signal, supply of operating power to a main switching device driving system that drives the main switching device.

2. A switching power supply apparatus having a serial circuit, including a primary coil of a transformer and a main switching device, connected between a positive and a negative power supply line connected to a direct-current power source, the switching power supply apparatus outputting a direct-current voltage obtained by rectifying with a rectifier a high-frequency voltage induced in a secondary coil of the transformer by the main switching device performing switching operation,

wherein the switching power supply apparatus further includes:

an output voltage detector that compares the direct-current voltage obtained through rectification with a predetermined reference voltage and that outputs a result of the comparison as a feedback signal;

a switching controller that drives and controls the main switching device

according to the feedback signal output from the output voltage detector;

a signal level checker that monitors a signal level of the feedback signal and that outputs an operation control signal for turning on and off the switching controller according to the monitored signal level; and

an operation/nonoperation switcher that is provided in a line by way of which the switching controller is supplied with operating power and that turns on and off the switching controller according to the operation control signal from the signal level checker,

the switching power supply apparatus outputting a desired voltage by driving the main switching device with a drive signal from the switching controller that is so turned on and off.

3. A switching power supply apparatus as claimed in claim 2,

wherein the feedback signal from the output voltage detector is transmitted to the switching controller through a photodiode of a photocoupler, and the signal level checker monitors the signal level of the feedback signal by comparing a current level flowing through a phototransistor of the photocoupler with a reference current level.

4. A switching power supply apparatus as claimed in claim 3,

wherein a current detection resistor is connected in series with the phototransistor of the photocoupler, and the signal level checker turns on and off the switching controller by feeding the switching controller with, as the operation control signal, a signal obtained by comparing a voltage drop across the current detection resistor with a voltage of a current level check reference power source.

5. A switching power supply apparatus as claimed in claim 3,

wherein operating power of the signal level checker and the phototransistor of the photocoupler is supplied from subsidiary control power extracted from a node between a plurality of diodes constituting a serial circuit provided in a steady-operation current supply line by way of which a voltage induced in a subsidiary coil of the transformer is supplied after being rectified with the plurality of diodes.

6. A switching power supply apparatus as claimed in claim 2,

wherein the operating power of the switching controller is supplied by way of a start-up current supply line by way of which a start-up current is supplied from the positive power supply line through a start-up resistor, or by way of a steady-operation current supply line by way of which a voltage induced in a subsidiary coil of the transformer is supplied after being rectified with a serial circuit composed of a plurality of diodes, and operating power of the signal level checker is supplied from subsidiary control power extracted from a node between the plurality of diodes.

7. A switching power supply apparatus as claimed in claim 2,

wherein the switching controller is realized as a PWM control circuit that outputs, as the drive signal with which to drive the main switching device, a pulse signal that is pulse-width-modulated according to a voltage level of the feedback signal from the output voltage detector.

8. A switching power supply apparatus as claimed in claim 7,

wherein used as the PWM control circuit is a PWM control IC that is realized as an integrated circuit chip having at least an FB terminal to which a voltage related to the

feedback signal is input and a CS terminal to which a voltage for enabling or disabling an internal circuit is input.

9. A switching power supply apparatus as claimed in claim 2,
wherein, when the PWM control IC is used as the switching controller,
a start-up corrector is additionally provided to correct start-up of the PWM control IC;
a first resistor is connected between the FB terminal of the PWM control IC and the negative power supply line;
the signal level checker feeds a CS terminal controller, which serves as the operation/nonoperation switcher, and the FB terminal with the operation control signal and an inverted feedback signal, respectively, according to a result of checking of the signal level of the feedback signal;
the CS terminal controller connects and disconnects the CS terminal of the PWM control IC to and from the negative power supply line according to the operation control signal; and
the start-up corrector connects and disconnects, through a second resistor, the FB terminal to and from the negative power supply line according to a voltage level of the subsidiary control power.

10. A switching power supply apparatus as claimed in claim 9,
wherein the CS terminal controller includes an NPN-type transistor having a collector thereof connected to the CS terminal of the PWM control IC, having an emitter thereof connected to the negative power supply line, and having a base thereof connected to the

collector of the other of the transistors included in the signal level checker.

11. A switching power supply apparatus as claimed in claim 9,

wherein the start-up corrector includes:

a serial circuit composed of a Zener diode and a plurality of resistors connected between a line of the subsidiary control power and the negative power supply line; and

an NPN-type transistor having a base thereof connected to a node between the resistors, having a collector thereof connected through the second resistor to the FB terminal of the PWM control IC, and having an emitter thereof connected to the negative supply power line.

12. A switching power supply apparatus as claimed in claim 9,

wherein the signal level checker includes, for generation of the reference voltage, voltage division resistors, of which a lower-potential-side resistor is divided into two resistors, with a node therebetween connected through a diode to the CS terminal of the PWM control IC.

13. A switching power supply apparatus as claimed in claim 9,

wherein the switching power supply apparatus further includes:

a capacitor connected between the CS terminal of the PWM control IC and the negative power supply line; and

a diode connected between the capacitor and the CS terminal.

14. A switching power supply apparatus as claimed in claim 2,
wherein the signal level checker includes a pair of transistors having emitters thereof connected together to form a comparator, with a base of one of the transistors connected to a node between the current detection resistor and the phototransistor, with a base of the other of the transistors connected to the current level check reference power source, with a collector of the one of the transistors connected to the FB terminal of the PWM control IC, and with a collector of the other of the transistors connected to the CS terminal controller.

15. A switching power supply apparatus as claimed in claim 2,
wherein, when the PWM control IC is used as the switching controller, the switching power supply apparatus further includes:

a current adjuster connected between the FB terminal of the PWM control IC and the negative power supply line to adjust a current output from the FB terminal according to the signal level of the feedback signal; and

a CS terminal controller that serves as the operation/nonoperation switcher by connecting and disconnecting the CS terminal of the PWM control IC to and from the negative power supply line according to an output signal of the signal level checker.

16. A switching power supply apparatus as claimed in claim 15,
wherein the current adjuster includes an NPN-type transistor having a collector thereof connected to the FB terminal of the PWM control IC, having an emitter thereof connected through a resistor to the negative power supply line, and having a base thereof connected to a line of the feedback signal.

17. A switching power supply apparatus as claimed in claim 15,

wherein the current adjuster includes an NPN-type transistor having a collector thereof connected to the FB terminal of the PWM control IC, having an emitter thereof connected through a resistor to the negative power supply line, and having a base thereof connected to a line of the feedback signal, and in series with the resistor connected between the base of the NPN-type transistor and the negative power supply line is connected an NPN-type transistor having a collector and a base thereof connected together.

18. A switching power supply apparatus having a serial circuit, including a primary coil of a transformer and a main switching device, connected between a positive and a negative power supply line connected to a direct-current power source, the switching power supply apparatus outputting a desired direct-current voltage by controlling the main switching device according to a feedback signal obtained as a result of comparison between a direct-current voltage obtained through rectification of a high-frequency voltage induced in a secondary coil of the transformer by the main switching device performing switching operation and a previously set reference voltage,

wherein

a signal level of the feedback signal is compared with a signal level of a previously generated oscillation signal;

according to a result of the comparison, an on-state duty of a drive signal to be fed to the main switching device is determined and switching between burst switching control and continuous switching control is performed; and

while switching operation of the main switching device is being stopped in burst switching control, supply of operating power for driving the main switching device is

stopped.

19. A switching power supply apparatus as claimed in claim 18,
wherein burst switching control is achieved by turning on and off supply of operating power to a switching controller that drives the main switching device.

20. A switching power supply apparatus as claimed in claim 18,
wherein, when the PWM control IC is used as the switching controller, a capacitor is connected between an FB terminal of the PWM control IC and an internal power terminal connected to an internal power supply line.

21. A switching power supply apparatus as claimed in claim 18,
wherein, when the PWM control IC is used as the switching controller, a serial circuit composed of a capacitor and a resistor is connected between an FB terminal of the PWM control IC and an internal power terminal connected to an internal power supply line.

22. A switching power supply apparatus as claimed in claim 2,
wherein, when the PWM control IC is used as the switching controller,
a start-up corrector is additionally provided to correct start-up of the PWM control IC;
a start-up switcher is additionally provided to turn on and off supply of operating power to the signal level checker;
a first resistor is connected between the FB terminal of the PWM control IC and the negative power supply line;

the signal level checker feeds a CS terminal controller, which serves as the operation/nonoperation switcher, and the FB terminal with the operation control signal and an inverted feedback signal, respectively, according to a result of checking of the signal level of the feedback signal;

the CS terminal controller connects and disconnects the CS terminal of the PWM control IC to and from the negative power supply line according to the operation control signal;

the start-up corrector detects whether or not the feedback signal is present so that, if the feedback signal is present, the start-up corrector connects, through a second resistor, the FB terminal of the PWM control IC to the negative power supply line and, if not, the start-up corrector cuts off the second resistor; and

the start-up switcher detects whether or not the feedback signal is present so that, if the feedback signal is present, the start-up switcher turns on supply of the operating power to the signal level checker and, if not, the start-up switcher turns off supply of the operating power to the signal level checker.

23. A switching power supply apparatus as claimed in claim 22,

wherein the start-up switcher includes an NPN-type transistor having a collector thereof connected to a node between a current detection resistor connected to a line of the feed back signal and an internal reference voltage line of the signal level checker, having a base thereof connected to the phototransistor, and having an emitter thereof connected to the negative power supply line.

24. A switching power supply apparatus as claimed in claim 22,

wherein the start-up corrector includes an NPN-type transistor having a collector thereof connected through the second resistor to the FB terminal of the PWM control IC, having a base thereof connected through a resistor to the phototransistor, and having an emitter thereof connected to the negative power supply line.

25. A switching power supply apparatus as claimed in claim 2,

wherein, when the PWM control IC is used as the switching controller,

a start-up corrector is additionally provided to correct start-up of the PWM control IC;

a first resistor is connected between the FB terminal of the PWM control IC and the negative power supply line;

the signal level checker feeds a CS terminal controller, which serves as the operation/nonoperation switcher, and the FB terminal with the operation control signal and an inverted feedback signal, respectively, according to a result of checking of the signal level of the feedback signal;

the CS terminal controller connects and disconnects the CS terminal of the PWM control IC to and from the negative power supply line according to the operation control signal; and

the start-up corrector detects whether or not the feedback signal is present so that, if the feedback signal is present, the start-up corrector connects, through a diode and the second resistor, the FB terminal of the PWM control IC to the negative power source line and turns on supply of operating power to the signal level checker and, if not, the start-up corrector cuts off the diode and the second resistor and turns off supply of the operating power to the signal level checker.

26. A switching power supply apparatus as claimed in claim 25,
wherein the start-up corrector includes an NPN-type transistor having a collector thereof connected through the diode and the second resistor to the FB terminal of the PWM control IC, having a base thereof connected through a resistor to the phototransistor, and having an emitter thereof connected to the negative power supply line.

27. A switching power supply apparatus as claimed in claim 25,
wherein the signal level checker includes, for generation of the reference voltage, voltage division resistors, of which a lower-potential-side resistor is divided into two resistors, with a node therebetween connected through a diode to the CS terminal controller, and the CS terminal controller is connected through another diode to the CS terminal of the PWM control IC.

28. A switching power supply apparatus as claimed in claim 2,
wherein, when the PWM control IC is used as the switching controller,
a start-up switcher is additionally provided to turn on and off supply of operating power to the signal level checker;
a current adjuster is additionally provided that is connected between the FB terminal of the PWM control IC and the negative power supply line to adjust a current output from the FB terminal according to the signal level of the feedback signal;
the signal level checker feeds a CS terminal controller, which serves as the operation/nonoperation switcher, with the operation control signal according to a result of checking of the signal level of the feedback signal;

the CS terminal controller connects and disconnects the CS terminal of the PWM control IC to and from the negative power supply line according to the operation control signal; and

the start-up switcher detects whether or not the feedback signal is present so that, if the feedback signal is present, the start-up switcher turns on supply of operating power to the signal level checker and, if not, the start-up switcher turns off supply of operating power to the signal level checker.